

Performance Assessment of the Mercury Laser Altimeter on MESSENGER from Mercury Orbit

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The Mercury Laser Altimeter (MLA) is one of seven instruments on the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft, a mission in NASA's Discovery Program. MESSENGER was launched on August 3, 2004, and entered into orbit about Mercury on March 18, 2011. MLA started to collect science measurements on March 29, 2011. As of June 30, 2011, MLA had accumulated about 3 million laser ranging measurements to the Mercury surface through one Mercury year, i.e., one complete cycle of the spacecraft thermal environment. The average MLA laser output-pulse energy remained steady despite the harsh thermal environment, in which the laser bench temperature changed by as much as 15°C over a 35-min operating period. The laser beam-collimating telescope experienced a 30°C temperature swing over the same period, and the thermal cycling repeated every 12 hours. Nonetheless, MLA receiver optics appeared to be aligned and in focus throughout these temperature excursions. The maximum ranging distance of MLA was 1500 km at near-zero laser-beam incidence angle (and emission angle) and 600 km at 60° incidence angle. The MLA instrument performance in Mercury orbit has been consistent with the performance demonstrated during MESSENGER's Mercury flybys in January and October 2008 and during pre-launch testing. In addition to range measurements, MLA data are being used to estimate the surface reflectance of Mercury at 1064 nm wavelength, including regions of permanent shadow on the floors of polar craters. MLA also provides a measurement of the surface reflectance of sunlight at 1064 nm wavelength by its noise counters, for which output is a monotonic function of the background light.